REMARKS

Reconsideration of this application is requested. Claims 6, 7, 9-12 and 30-32 are active in the application subsequent to entry of this amendment.

Counsel affirms the election of claims 8-21, Group II. The remaining claims have been withdrawn as directed to non-elected subject matter and cancelled. This action being taken without prejudice to divisional applications directed to the subject matter of these claims.

In the Office Action, claims 11 to 12, 15 to 16 and 21 are rejected since the wording "in the vicinity" used in them is regarded as indefinite. As used in applicants' specification the wording "in the vicinity" does not mean a certain local portion. As described since the raw material for carbon black is fed to the second reaction zone, it is important to define atmospheric conditions of the second reaction zone (such as temperature and oxygen concentration) upon feeding the raw material thereto, because these conditions considerably influence the quality and yield of the obtained carbon black. Thus, the wording "in the vicinity" means in the second reaction zone.

See the following (first paragraph on page 4 of the specification):

Therefore, for effecting uniform gasification and thermal decomposition of the feedstock hydrocarbon and for obtaining carbon black of small particle size, it is important to place the second reaction zone under a sufficient degree of high temperature atmosphere.

Also see the following (second paragraph on page 5 of the specification):

The upshot is that in the production of carbon black, elevation of gas temperature at the feedstock hydrocarbon feed position leads to high-yield production of high-quality carbon black which is small in size and has a narrow distribution of particle size and agglomerate size, without reducing productivity.

If the fuel is incompletely burned in the first reaction zone, the temperature and oxygen concentration of the second reaction zone subsequent thereto are varied depending upon the difference in fuel combustion method and furnace shape. Therefore,

in the carbon black production furnace, the temperature and oxygen concentration of the first reaction zone are not so important—what is important is that the combustion is completed such that the temperature and oxygen concentration of the second reaction zone reach the desired ranges. Claims 11, 12, 15, 16 and 21 are amended to reflect those passages of the specification.

The balance of the issues raised in the Official Action relate to prior art and specifically the citation and application as prior art of U.S. 5,772.975 assigned to the owners of the present application and having patentee Fukuyama as a common inventor in respect of the present application. Applicants are, of course, aware of the content of this document and drafted their claims to distinguish from the disclosures of this citation. In fact, the present invention is an improvement over the disclosures of the document cited.

U.S. 5,772,975 describes a carbon black production furnace similar to that of the present invention. In the drawings of this patent, there is, at first glance, shown a furnace in which the fuel feed port and the oxygen-containing gas feed port are opened to a side surface of an inner wall (corresponding to the first reaction zone of the present invention) of the furnace in a spaced relation to each other. However, the carbon black production furnace described in this patent is not a furnace capable of high-temperature air combustion as described in the present invention – it is merely an ordinary combustion furnace. To illustrate this, as is apparent from the burner shown in Fig. 1 (combination of the fuel feed port and the oxygen-containing gas feed port), a flame is generated at a tip end of the elongated fuel feed port provided at a central portion of the inner wall of the furnace. This flame produces the combustion gas flow.

By contrast, in the combustion furnace of the present invention, the fuel feed port and the oxygen-containing gas feed port are opened on the surface of the first reaction zone in a spaced relationship to each other, and its structure is different from that of the furnace of the patent. Only with the structure of the furnace according to the present invention, is it possible to generate a convection current of the oxygen-containing gas within the furnace to raise the temperature of the gas. Further, this high-temperature

oxygen-containing gas is used for combustion in the furnace, makes it possible to realize high-temperature air combustion.

Original dependent method claim 8 has been revised in independent form to include the features of the apparatus of claims 1 and 4. The method is thus for a process of continuously supplying to a first reaction zone through at least one feed port an oxygen-containing gas and, through a separate feed port, a fuel, continuous operation being disclosed in the specification at page 19, line 9. The rate of supply of the oxygen-containing gas and the fuel are controlled independently of each other (see page 14 last paragraph) and both types of ports open into the reaction zone from the same direction (see page 14, last 5 lines). Importantly, as featured in original claim 4, the oxygen-containing gas is fed into the first reaction zone through a non-circular port the advantages of which are described in the specification, in particular the first full paragraph of page 22.

In the above claim amendments new claim 30 represents a combination of claims 1, 4 and 8 while claims 31 and 32 are drafted and directed to the features of original apparatus claims 2 and 3. Original apparatus claims 6 and 7 have been revised and "converted" into method claims while the remaining dependent claims have been amended, where appropriate, to address clarity issues raised in the Official Action.

Original claims 8 and 10-16 were rejected as being anticipated by and remaining claims 9 and 17-21 as being anticipated by or obvious over the disclosures of the cited patent. These rejections are traversed to the extent that the examiner's concerns may extend to the new and amended claims presented above. In order to reduce issues claims 13-21 have been withdrawn.

U.S. 5,772,975 is an example of the carbon black production furnaces in which a raw hydrocarbon feed zone is heated to a high temperature. However, in the case of the conventional combustion method, it is necessary that the adiabatic flame temperature at the combustion portion is far higher than the gas temperature at the raw hydrocarbon feed zone. For example, to maintain the raw hydrocarbon feed zone at a temperature of 1,800°C or higher, it is necessary to raise the adiabatic flame temperature at the

combustion portion to 2,100°C or higher. Since the use of such a high temperature tends to cause severe damage to refractory materials constituting the furnace, prior to the present invention it has been difficult to operate the furnace in a stable and continuous manner.

In addition, if the oxygen concentration is reduced such that the air ratio approaches 1, soot tends to be generated at the combustion portion, and this causes the obtained carbon black product to be deteriorated in quality.

As a result of various studies on optimum combustion methods for solving these problems, the present invention has been attained. The present invention is an improvement over and is not suggested from the teaching of U.S. 5,772,975.
The essential features of the present invention are as follows:

Applicants' method attains in a carbon black production furnace "diffusion combustion" (i.e., a so-called high-temperature air combustion) in which, as described in applicants' specification, the oxidation exothermic reaction proceeds at a sufficiently low velocity in the presence of high-temperature diluted air which has an oxygen concentration far lower than that of ordinary air. This provides a temperature higher than the combustion stabilizing limit temperature of the mixed gas at the oxygen concentration at least immediately before the combustion reaction, or a corresponding oxidizing agent. As a result, it is possible to prevent refractory materials constituting the wall of the reaction furnace form being damaged, and provides a means to stably produce carbon black having a smaller particle diameter, a sharp agglomerate diameter and good physical properties.

The process for producing carbon black as claimed in claim 30 can be realized only by using the combustion apparatus as claimed in previous claims 1 and 4 including a three zoned arrangement in which the feed port is non-circular. This is neither described nor suggested in the prior art.

The flow rate of the oxygen-containing gas as claimed in claim 9 is a very important factor in order to attain an exhaust gas self-recycling effect employing the exhaust energy and absorb the ambient combustion gas to reduce the oxygen

concentration of the combustion air and reduce the flame temperature upon the combustion. Also, this feature is neither described nor suggested in the prior art.

Claims 10 to 12, define the temperature and oxygen concentration at which the effect of the high-temperature air combustion can be more effectively exhibited. High-temperature air combustion can be stably performed in such a combustion zone only by using the above-described apparatus. This feature is neither described nor suggested in the prior art.

For the above reasons it is respectfully submitted that the claims of this application define inventive subject matter. Reconsideration and allowance are solicited.

Respectfully submitted,

NIXON & VANDERHYE P.C.

By: 

Arthur R. Crawford
Reg. No. 25,327

ARC:pfc
1100 North Glebe Road, 8th Floor
Arlington, VA 22201-4714
Telephone: (703) 816-4000
Facsimile: (703) 816-4100